

What is claimed is :

1- A device for occluding a hole existing in a body wall, insertable by a mini-invasive route, characterised in that it comprises:

- 5       - a single disk, of diameter greater than the diameter of the hole to be treated, composed of a deformable peripheral thread made of shape memory material, and of a flexible wall made of a biocompatible material connected to said thread, whereas said disk is deformable between a normal deployment state, wherein it may be pressed against said body wall and brought to cover  
10 the complete hole to be treated, while extending over said hole, and a contraction state, wherein it may be inserted into a sheath enabling to run it towards said body wall for being inserted therein, whereas the disk comprises means for removable link thereof with a handling rod, enabling to insert said disk and to maintain it pressed against said body wall ; and
- 15       - at least one attachment separated from the disk, enabling to fasten said disk to said body wall, whereas each attachment comprises a zone for linking to the disk and a zone for linking to the body wall and which may be deformed in order to engage into a hollow needle.

2- A device according to claim 1, characterised in that the means for  
20 removable link of the disk to the handling rod comprise a radial thread interconnected with said peripheral thread of the disk, including at the centre of the disk, a tapped socket, whereby said handling rod contains a threaded end which may be screwed into said socket.

3- A device according to claim 1, characterised in that said linking  
25 zones included in each attachment are in the form of two distant deployable bearing surfaces, separated from one another by a tapered intermediate portion of length corresponding substantially to the added thickness of said body wall and of said flexible wall of the disk; whereas one of said bearing surfaces of the attachment is intended for resting against said flexible wall of  
30 the disk and the other bearing surface of this attachment is intended for resting against said body wall, on the side of this wall opposite the disk, said tapered intermediate portion being intended for running through said body wall.

4- A device according to claim 3, characterised in that the bearing surfaces are in the form of spirals formed by a thread making up the attachment, or in the form of branches or radial wings.

5 5- A unit for inserting the device according to claim 1, characterised in that it comprises:

- said sheath, liable to receive the disk in said contraction state of this disk and to contain said handling rod;

- at least one catheter containing said hollow needle, this needle being made of a shape memory material and deformable between a substantially linear shape, which it adopts when inserted into the catheter, and a shape wherein its free end portion is offset laterally relative to its other end portion, a shape which it adopts when pushed outside the catheter, such offset being such that it enables said free end portion to face the zone of said body wall covered with said flexible wall of the disk and to go through said zone when the needle is pushed outside the catheter ; and

- a control rod, engaged into the catheter and connected removably to said attachment, enabling to control the sliding of this attachment through said needle.

20 6- A unit according to claim 5, characterised in that the catheter may slide along said handling rod and in that the handling rod comprises a stop enabling axial positioning of the catheter relative to the disk in order to offset suitably said free end portion of the needle.

7- A unit according to claim 5, characterised in that the catheter is mounted to pivot around the handling rod.

25 8- A unit according to claim 6, characterised in that the catheter and the handling rod comprise respectively a mark and a graduation enabling to position the catheter angularly relative to the handling rod.

9- A unit according to claim 5, characterised in that it comprises several catheters arranged angularly according to the different implantations of the attachments to be provided.

30 10- A unit according to claim 5, characterised in that the means for removable linking of the control rod and of the attachment are in the form of a tapped socket and of a threaded end which may be screwed into said socket.

11- A unit according to claim 5, characterised in that the needle includes a lateral slot at its distal end and is fitted with a removable means for occluding said slot, notably in the form of a flexible tube sliding inside the needle.

5 12- A unit according to claim 11, characterised in that the distal end of the needle is full, forming a cul-de-sac.

13- A surgical process for mini-invasive occlusion of a hole existing in a body wall comprising the following steps:

10 - using a single disk, of diameter greater than the diameter of the hole to be treated, composed of a deformable peripheral thread made of shape memory material, and of a flexible wall made of a biocompatible material connected to said thread, whereas said disk is deformable between a normal deployment state, wherein it may be pressed against said body wall and brought to cover the complete hole to be treated, and a contraction state,  
15 wherein it may be inserted into a sheath enabling to run it towards said body wall for being inserted therein, whereas the disk comprises moreover means for removable link thereof with a handling rod, enabling to insert said disk and to maintain it pressed against said body wall ; and

20 - using at least one attachment separated from the disk, enabling to fasten said disk to said body wall, whereas each attachment comprises two distant deployable bearing surfaces, separated from one another by a tapered intermediate portion of length corresponding substantially to the added thickness of said body wall and of said flexible wall of the disk, the attachment being liable to be deformed to be engaged into a hollow needle ; whereas one  
25 of said bearing surfaces of the attachment is intended for resting against said flexible wall of the disk and the other bearing surface of this attachment is intended for resting against said body wall, on the side of this wall opposite the disk, said tapered intermediate portion being intended for running through said body wall ;

30 - using a unit for inserting the device including: (i) said sheath, liable to receive the disk in said contraction state of this disk and to contain said handling rod; (ii) at least one catheter containing said hollow needle, this needle being made of a shape memory material and deformable between a substantially linear shape, which it adopts when inserted into the catheter, and

a shape wherein its free end portion is offset laterally relative to its other end portion, a shape which it adopts when pushed outside the catheter, this offset being such that it enables said free end portion to face the zone of said body wall covered with said flexible wall of the disk and to go through said zone when the needle is pushed outside the catheter ; and (iii) a control rod, engaged into the catheter and connected removably to said attachment, enabling to control the sliding of this attachment through said needle ;

5 - routing the disk, connected to the handling rod, towards the body wall to be treated using said sheath, then deploying this disk by retraction of said sheath and pressing the disk against the body wall by means of the handling rod;

- pushing the hollow needle outside the catheter containing said needle in order to offset the free end portion thereof, then inserting it through said zone of the body wall covered by the flexible wall of the disk;

15 - pushing the attachment through the needle by dint of said control rod in order to extract one of the bearing surfaces of the attachment outside the needle and to deploy this surface, then retracting the needle in order to extract said tapered intermediate portion and the other bearing surface from the attachment so that said other bearing surface rests against the body wall on the side opposite that against which the disk rests.

20 14- A surgical process according to claim 13, characterised in that attachments are placed on the whole periphery of the disk, in order to hold said disk against the body wall and to provide permanent occlusion of the hole contained in said wall.

25 15- A surgical process according to claim 13, characterised in that one or several attachments are inserted on a marginal sector of the periphery of the disk, so that the disk does not occlude permanently the hole to be treated and may operate like a flap.